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To: Dr. Jerry Whidby Date: August 10, 1992
From: R. W. Dwyer
Subject: 1993 Operational Plan for Project Tomorrow

PROGRAM GOAL

The goal of Project Tomorrow is to evaluate the feasibility of developing cigarette ignition-propensity tests, and to determine the technical and commercial feasibility of making cigarettes with substantially reduced ignition propensities as demonstrated by such tests.

STATUS AND BACKGROUND

Much of the work on the development of a reproducible and reliable test method for measuring cigarette ignition propensities is now done in conjunction with a Federal study under the Fire Safe Cigarette Act. This Act, which became law on August 10, 1990, empowers the Consumer Product Safety Commission to direct the National Institute of Standards and Technology to complete research on cigarette fire safety. Specifically, the law directs NIST to develop a standard method for determining cigarette ignition propensities, to compile performance data for cigarettes using the standard method, and to conduct laboratory studies on and computer modeling of ignition physics. The CPSC is directed to design and implement a study to collect baseline and follow-up data about the characteristics of cigarettes involved in fires, the types of products which are ignited by cigarettes, and the smokers involved; further, they are to develop information on the societal costs of cigarette-initiated fires. The CPSC, with the Department of Health and Human Services, is to develop information on changes in the toxicity of smoke and any resultant health effects from cigarette prototypes. The law calls for CPSC to submit a final report to Congress by August 10, 1993, and to provide an assessment of the practicality of a cigarette fire-safety performance standard.

NIST is in the process of developing both primary and secondary cigarette ignition-propensity tests. Philip Morris is cooperating with NIST in developing these tests, and we, CPSC, and NIST are scheduled to begin a preliminary protocol-evaluation phase this month. After the completion of this phase, a ten-laboratory round-robin test is planned for the last quarter of this year.

Our research has shown, and it is confirmed by the literature^{1,2} that cotton fabrics without high levels of burn promoters *are not susceptible to ignition by smoldering*

¹ Robert J. McCarter, Fire Science Division, Center for Fire Research, NBS: *Smoldering Combustion of Cotton and Rayon*, Journal of Consumer Product Flammability, Vol. 4, pp 346-358 (1977)

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cigarettes. Whether or not a fabric can be ignited by a smouldering cigarette depends on the fabric's burn-promoter content. Therefore, ignition tests are dependent on fabrics which contain high levels of burn promoters. The Joint Venture on Ignition Propensity Test Development is in the process of documenting this observation more fully. The Joint Venture has obtained 500 different upholstery fabrics. Each of these fabrics were screened for ignitability using an experimental cigarette type which NIST had found to have a high ignition propensity. We found 145 of the 500 fabrics to be ignitable by this high-IP cigarette in the as-received condition. Since then, we have had the 145 fabrics rinsed in cold water. These fabrics are to be re-tested for ignition propensity later this month.

We are examining a number of means for evaluating cigarette ignition propensities. In performing primary testing, the outcomes generally fall into two categories: ignitions and extinguishments, or non-ignitions and extinguishments. Whether the fabric sustains smolder is a fabric property, i.e., the outcome depends on the burn-promoter content of the fabric. However, extinguishments appear to be affected by properties of both cigarettes and fabrics. The NBS ranked thirty-two experimental cigarettes in the original TSG report of 1987. Four cigarette manufacturers re-made these models earlier this year. Experimental models with low TSG ignition propensities tend to have higher extinguishment potentials on a given fabric. We also find that as the fabric basis weight increases, the percent extinguishments of a given cigarette design increases.

Our challenge has been to find test conditions which can discriminate among experimental cigarettes in the higher NBS-IP range. We are continuing to examine the influences of test materials, configurations, and conditions. The fourth CORESTA collaborative study has been planned and should be implemented in the last quarter of this year. In this study, we are examining the effects of fabric burn-promoter type and level on experimental cigarette ignition propensities.

We are working with the Paper Technology Group to evaluate the effects of banded wrappers on cigarette ignition propensities. Cigarettes made with wrappers having bands of Avicel show variable burn rates. The coals progress normally along the tobacco rod until they reach the band. In the banded region the linear burn rate is reduced in proportion to the amount of Avicel on the wrapper; if the Avicel content is high enough, the coal will extinguish in the band during free smolder. Cigarettes made with experimental wrappers containing three bands have been produced experimentally and are being prepared for testing. The greatest problem with this project is obtaining reliable samples. The technology required for the consistent application of a target amount of material in a fixed location on the paper is not currently available. Further, the technology to register the bands during cigarette making is not available. These areas are being investigated.

We are also working with Product Development and the Leaf Department to design low-density cigarettes with low mass burn rates. Various designs have been made which have low mass burn rates. Leaf is seeking low-density blends for these samples using both DIET and NET technologies. Product Development is having the samples made, CTSD-tested, and subjectively evaluated. Some candidates have been produced which have met

² Darrell J. Donaldson, D.A. Yeadon, and R.J. Harper, Southern Regional Research Center: *Smoldering Phenomenon Associated with Cotton*, Textile Research Journal, Vol. 53, pp 160-164 (1983)

our MBR targets. However, all have been found subjectively unacceptable. Further work is required with these designs.

STRATEGIES

~In order to achieve our goal, we are pursuing four strategies for this program:

1. Evaluate the feasibility of developing scientifically valid and reproducible cigarette ignition-propensity tests which will reflect real-world conditions, and evaluate the technical and commercial feasibility of making cigarettes with reduced ignition propensities with respect to such tests.
2. Evaluate the mechanisms of cigarette-initiated fabric ignitions and attempt to develop a computer model of a cigarette interacting with a substrate.
3. Determine the effects of banded wrappers on cigarette ignition testing.
4. Continue to pursue the design of cigarettes at reduced mass burn rates which demonstrate subjectively acceptable performance properties.

Strategy I. Test Development

Tactics and Timetable

1. Complete the NIST ignition-propensity round robin and evaluate the effects of cigarette design, test materials, and test conditions on the results. (1Q93)
2. Investigate the influence of banded wrapper designs on IP tests with cotton ducks and filter papers. (1Q93)
3. Evaluate the effects of cigarette-design variables on cotton duck fabrics and filter papers in both flat and crevice configurations. (3Q93)
4. Evaluate the NIST IP-tests which are anticipated to be incorporated in the final report of the TAG. (2Q93)
5. Determine the effects of cigarette design on the NIST primary and secondary tests. (4Q93)

Resource Requirements

Test Manager/Data Analyst	0.5
Test Technicians	3.0
Project Leader	0.4

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Strategy 2. Mechanisms and Models

Tactics and Timetable

1. Investigate the influence of bands on extinguishments using neutron and X-ray radiography. (1Q93)
2. Experimentally evaluate the roles of heat conduction and oxygen blockage in extinguishments. (2Q93)
3. Determine the influence of wrapper properties on the mass of tobacco consumed during a puff using neutron radiography. (3Q93)
4. Use IR, Schlieren, X-ray, and neutron imaging to examine the cigarette and substrate structures during smouldering. (3Q93)
5. Combine the cigarette and substrate models in an attempt to predict the effects of cigarette design, fabric and foam materials, and experimental conditions on ignition. (4Q93)

Resource Requirements

Radiographer	0.3
Thermal Physicists	2.0
Combustion Modelers	2.0
Project Leader	0.1

Strategy 3. Banded Wrappers

Tactics and Timetable

1. Attempt to develop banded cigarette paper capability at a pilot facility. (on-going)
2. Explore improving the properties of Avicel to meet subjective requirements. (on-going)
3. Evaluate the influences of band mass, width, and spacing on ignition tests. (2Q93)
4. Evaluate the influences of band mass, width, and spacing on the NIST ignition tests. (3Q93)
5. Attempt to develop commercial banded-wrapper technology and capability in conjunction with outside paper manufacturers. (on-going)

Resource Requirements

Paper Technologist	1.5
Cigarette Designer	0.3
Test Technician	0.2
Project Leader	0.1

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Strategy 4. New Cigarette Designs

Tactics and Timetable

1. Attempt to optimize the properties of low-MBR, low-density designs. (on-going)
2. Test such designs with the NIST primary and secondary methods. (on-going)
3. Attempt to redesign and reformulate all of our cigarette brands to meet the NIST primary and secondary standards. (on-going)

Resource Requirements

Cigarette Designer	2.0
Blend Designer (Leaf Department)	2.0
Flavor Scientist	2.0
Cigarette Production Administrator	2.0
Test Technician	0.3
Semiworks, CTSD, and NET Support	2.0
Project Leader	0.4

RESOURCE REQUIREMENTS SUMMARY

Test Manager/Data Analyst	0.5
Test Technicians	3.5
Radiographer	0.3
Thermal Physicists	2.0
Combustion Modelers	2.0
Paper Technologist	1.5
Cigarette Designer	2.3
Blend Designer (Leaf Department)	2.0
Flavor Scientist	2.0
Cigarette Production Administrator	2.0
Semiworks, CTSD, and NET Support	2.0
Project Leader	1.0
TOTAL	21.1

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